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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/736,812	12/14/2000	Steven L. Smith	81940DMW	8696

7590 06/03/2004

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EXAMINER	
TUCKER, WESLEY J	
ART UNIT	PAPER NUMBER
2623	8

DATE MAILED: 06/03/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/736,812	SMITH ET AL.
	Examiner	Art Unit
	Wes Tucker	2623

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 March 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's response to the last Office Action, filed December 24, 2003 has been entered and made of record.

2. Applicant has amended Claims 1, 4, 5, and 6 and added Claims 7-11. Claims 1-11 are pending.

3. Applicant's arguments have been fully considered but are not persuasive for at least the following reasons:

4. With regard to applicant's remarks on the amendments to claims 1, 4, 5, and 6, the rejection under 103 from the combination of Wober and Fiete is still considered valid. Wober still teaches the transformation into an advantageous electromagnetic spectral space in the transformation from RGB to YUV space (column 8, lines 24-36). Wober also teaches the use of information from "other spectral bands" in the practice of converting RGB to YUV. All of the spectral bands from the RGB must be used to determine the YUV representation.

5. With regard to applicant's remarks as to the motivation of combining the references of Fiete and Wober, the order of inventions or the times at which the previous inventions were made is irrelevant to the combination of those references. Motivation for the obvious combination of two references relies upon whether the two references can be combined at the time at which the present invention's application was filed. Therefore the combination of references Wober and Fiete is not speculation.

Claim Rejections - 35 USC § 112

Claims 1 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The amended claim 1 includes the phrase "from an original space of the electromagnetic spectrum to a space of the electromagnetic spectrum advantageous for streak removal." This limitation is only briefly mentioned in the background of the invention and is not disclosed in the description of the invention. In fact the word "electromagnetic" only appears in the background of the specification.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,729,631 to Wober in view of U.S. Patent 5,881,182 to Fiete.

With regard to claim 1, Wober discloses a method of removing noise from multi-band digital images in an original spectral space, said method comprising the steps of

a) selecting a plurality of bands of a multi-band image to perform noise removal operation upon (column 2, lines 37-47). Wober discloses removing noise from an image by performing noise modeling after converting an RGB image to YUV space. RGB is considered a plurality of bands.

b) transforming each of the bands of the multi-band image from an original spectral space of the electromagnetic spectrum to a spectral space of the electromagnetic spectrum advantageous for noise removal for multi-band imagery (column 8, lines 24-36). Wober discloses transforming the image from RGB space to YUV space.

c) performing a noise removal operation on each band in the advantageous spectral space using information from the other spectral bands (column 8, lines 54-68 and column 9, lines 1-5). Here Wober discloses noise modeling in each of the YUV bands. It is understood that the conversion to YUV from RGB requires information from the other original spectral bands.

Wober does not disclose applying the noise removal to removing streaks. However streaks are a well known from of noise. For example Fiete discloses removing streaks, as a type of noise, from images. Fiete states that "streaks not only reduce the aesthetic quality of digital images but can impact the interpretability of features in the images. Streaking also severely degrades the performance of pattern recognition and feature extraction software" (column 1, lines 60-64). Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to apply Wober's method, to remove unwanted streaks as taught by Fiete in order to increase the aesthetic quality of the image as well as provide better interpretability of the image for use with pattern recognition and feature extraction software.

With regard to claim 2, Wober discloses a method wherein the spectral space advantageous for noise removal for multi-band imagery is dependent on at least one of the number of the bands of data, and the spectral band pass of each of the imaging bands (column 8, lines 37-47). Here Wober describes

the advantageous spectral space as a YUV representation, which must use information from all of the other spectral bands of the RGB space. Wober further discloses a method wherein the spectral space advantageous for noise removal for multi-band imagery is dependent on imaging band dependent characteristics of the one or more sensors used to capture the bands (column 3, lines 48-52). Here the sensors used to capture bands are included in the hardware of a noise removal system which includes a discrete cosine transform processor and a Wiener filter combined for removing all frequencies of noise from an image. The discrete cosine transform processor is used to capture the bands and is dependent on frequencies of image signal. In the Wober-Fiete combination, the technique would be applied to streak removal as discussed with respect to claim 1.

With regard to claim 3, Wober discloses the transformation performed in step b) consists of a linear combination of the original bands (column 8, lines 24-36). Wober discloses transforming the RGB image into a YUV space. This is considered a linear combination of the RGB bands into YUV bands. In the Wober-Fiete combination, the technique of linear combination of bands would be applied to the method for streak removal as discussed with respect to claim 1.

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,881,182 to Fiete in view of Patent 5,729,631 to Wober.

With regard to claim 4, Fiete discloses a method of removing columnar streaks from a multi-band digital image of the type in which it is assumed that pixels in a predetermined region near a given pixel spatially and spectrally relative to the electromagnetic spectrum are strongly related to each other and employing gain and offset values to compute streak removal information comprising: testing for a strong relation between the pixels in a predetermined spatial and spectral region near a given pixel and

computing streak removal information only if such a strong relationship exists, whereby image content that does not extend the full length of the image in the column direction will not be interpreted as a streak (See Abstract). As to the new limitation of a predetermined region <u>spatially and spectrally relative to the electromagnetic spectrum</u>, if the pixels are closely related in the spatial domain, then they are also related in whatever electromagnetic spectrum that is in use.

Fiete does not disclose the improvement comprising: transforming the pixels of the multi-band image to a spectral space advantageous for streak removal, wherein the transformation is a linear combination of at least two of the original bands. Wober discloses this improvement (column 8, lines 24-37). Wober discloses converting the RGB image input into YUV space. This is a linear combination of the original bands.

Wober teaches "Signal dependent noise which is much more difficult to reduce than additive noise, can be reduced by first transforming the noisy signal into a domain where the noise becomes signal independent, then removing the signal independent noise using a conventional method such as Wiener filtering." Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to perform the streak removal method of the patent after transforming bands of a multi-band signal to a spectral space advantageous for streak removal or noise removal, because the noise or streaks could be made signal independent in the frequency domain and thus easier to remove.

With regard to claim 5, Fiete discloses a method of removing streaks in a digital image, said method comprising steps b) through h).

b) detecting pixel locations in the image where pixel-to-pixel differences caused by streaking can be distinguished from normal variations in the scene data (column 2, lines 48-51);

c) performing a linear regression to determine an initial estimate of the gain and offset values between each pair of adjacent pixels in a direction perpendicular to the streaking using the pixel values at the detected locations (column 2, lines 51-53);

d) performing a statistical outlier analysis to remove the pixel values that are not from streaking (column 2, lines 53-54);

e) performing a linear regression to determine the gain and offset values between each pair of adjacent pixels in a direction perpendicular to the streaking using the pixel values at the detected locations that are not statistical outliers (column 2, lines 55-60);

f) setting the slope value to unity if it is not statistically different from unity (column 3, lines 55-60);

g) setting the offset value to zero if it is not statistically different from zero (column 2, lines 55-60);

h) using the slope and offset values to remove streaking from the corresponding line of image data (column 2, lines 55-60);

Fiete doses not disclose steps a) and i).

Wober discloses step a) transforming a multi-band image to a spectral space advantageous for noise removal for multi-band imagery, thereby forming a transformed image (column 8, lines 24-36). Wober discloses reducing noise in an original spectral space after converting the image from RGB to YUV.

Wober also discloses step i) transforming the streak removed transformed image from the advantageous spectral space back to the original display space (see abstract). Here Wober discloses "the image is restored with reduced noise."

Wober teaches "Signal dependent noise which is much more difficult to reduce than additive noise, can be reduced by first transforming the noisy signal into a domain where the noise becomes signal independent, then removing the signal independent noise using a conventional method such as Wiener filtering" (column 8, lines 37-47). Therefore it would have been obvious to one of ordinary skill in

the art at the time of invention to perform the streak removal method of the Fiete after transforming bands of a multi-band signal to a spectral space advantageous for streak removal or noise removal, because the noise or streaks could be made signal independent in the YUV space and thus easier to remove. Then of course the noised reduced image could be transferred back to the original display space.

With regard to claim 6, Fiete discloses a method for removing columnar streaks in a digital image, comprising steps b) through e) and g) through r), but not steps a), f), and s).

b) selecting first and second adjacent columns of pixels from the transformed digital image (Fig.4A, element 30);

c) forming a column of pixel value pairs, representing the pixel values of the adjacent pixels in the two columns (Fig.4A, element 32);

d) forming columns of local mean values, representing the mean values of pixels in an N-pixel window for each column (Fig.4A, element 34);

e) forming columns of mean-reduced values, representing the pixel value minus the corresponding local mean values in each column (Fig.4A, elements 36 and 38);

g) forming a column of difference metric values, representing the sum of the squares of the difference between corresponding mean reduced values in an N pixel window (Fig.4A, element 38);

h) forming a first reduced column of pixel value pairs by removing from the column of pixel value pairs, those pixel values whose absolute difference between the pairs is greater than a predetermined difference threshold (Fig.4A, element 38);

i) forming a second reduced column of pixel value pairs by removing from the first reduced column of pixel value pairs, those pixel values whose corresponding difference metric values are greater than a predetermined difference metric threshold (Fig.4A, element 38);

j) forming first slope, offset, and standard error values by performing a linear regression between the pair of pixel values in the second reduced column of pixel value pairs (Fig.4A, element 40);

k) forming a column of linear prediction values using the slope and offset values and the first pixel value of the pair of pixel values in the second reduced column of pixel value pairs (Fig.4A, element 42);

l) forming a column of regression error values, representing the difference between the second pixel value of the pair of pixel values in the second reduced column of pixel value pairs (Fig. 4B, element 44);

m) forming a third reduced column of pixel value pairs by removing from the first reduced column of pixel value pairs, those pixel values whose corresponding regression error values are greater than a predetermined regression error threshold related to the standard error value (Fig. 4B, element 48);

n) forming second slope and offset values by performing a linear regression between the pair of pixel values in the third reduced column of pixel value pairs (Fig. 4B, element 50);

o) setting the second slope value equal to unity if it is determined to not be statistically different from unity (Fig. 4B, element 52);

p) setting the second offset value equal to zero if it is determined to not be statistically different from zero (Fig. 4B, element 56);

q) adjusting the value of each pixel in the second column of pixels in the digital image by multiplying each value by the second slope value and then subtracting the second offset value (Fig. 4B, element 58);

r) repeating steps a-o for all adjacent columns of pixel values in the image (column 2, lines 37-40);

Fiete does not disclose steps a), f), and s)

Wober discloses steps a), f), and s).

Wober discloses step a) transforming the multi-band image to a spectral space advantageous for noise removal for multi-band imagery, thereby forming a transformed image (column 2, lines 37-41). See discussion for claim 5a.

Wober also discloses step f) calculating the correlation between bands in the local region. The filtering for each band depends on the other spectral bands or range of frequencies because of the way the RGB image is used to determine the YUV image. Each Y, U, or V is determined using all of the bands in RGB space. YUV is considered to determine the correlation between R. G, and B spectrums, and the noise modeled in the Y, U, and V models is considered to take into account the correlation of the bands. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to calculate the correlation between bands in the local region in order to calculate the noise associated with different bands.

Wober also discloses step s) transforming the streak removed transformed image from the advantageous spectral space back to the original display space (see abstract). See discussion for claim 5i.

With regard to claim 7, Wober and Fiete disclose the method as claimed in Claim 1 further comprising: d) transforming the noise removed bands from the advantageous spectral space back to the original display space (see abstract). Here Wober discloses “the image is restored with reduced noise.” So after the noise is reduced, the image is restored in the original spectral space.

With regard to claim 8, the discussion of claim 4 applies. The combination of Wober and Fiete disclose a method of removing streaking in a digital image having a plurality of electromagnetic spectral bands.

Wober discloses transforming the image from a first spectral space of the electromagnetic spectrum to a second spectral space of the electromagnetic spectrum, said second spectral space being advantageous for noise removal, thereby forming a transformed image (wober, column 8, lines 24-37), but does not disclose removing streaks explicitly.

Fiete discloses detecting pixel locations in the transformed image where pixel-to-pixel differences caused by streaking can be distinguished from normal variations in the scene data (Fig. 4A).

Fiete further discloses removing streaking from the image data to provide a streak removed transformed image (column 2, lines 33-43).

Wober discloses transforming the streak removed transformed image from the second spectral space back to the first spectral space (abstract). Wober discloses restoring the noise-removed image.

The references of Wober and Fiete are combined in the same way as in reference to claims 1-6.

With regard to claim 9, the combination of Wober and Fiete in regard to claim 4 applies. Fiete discloses streak removal wherein said removing streaking further comprises the steps of performing a linear regression to determine an initial estimate of the gain and offset values between each pair of adjacent pixels in a direction perpendicular to the streaking using the pixel values at the detected locations; performing a statistical outlier analysis to remove the pixel values that are not from streaking; performing a linear regression to determine the gain and offset values between each pair of adjacent pixels in a direction perpendicular to the streaking using the pixel values at the detected locations that are not statistical outliers; setting the slope value to unity if it is not statistically different from unity; setting the

offset value to zero if it is not statistically different from zero; and using the slope and offset values to remove streaking from the corresponding line of image data (Fig. 4A). Fig. 4A discloses all of the above steps as discussed in regard to claim 4.

With regard to claim 10, the combination of Wober and Fiete applies as in regard to claim 1.

With regard to claim 11, the combination of Wober and Fiete applies as in regard to claim 6.

Conclusion

Applicant's amendment necessitated the new grounds of rejection presented in the Office Action. Accordingly, THIS ACTION IS MADE FINAL. See MPEP 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wes Tucker whose telephone number is 703-305-6700. The examiner can normally be reached on 9AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703)308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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5-30-04

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